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DEMOGRAPHIC PRESSURE AND URBAN SPRAWL ON LAND USING GEOSPATIAL ANALYSIS IN THANJAVUR CITY, INDIA

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ABSTRACT

India has many resources with rapid population growth necessitates a proper planning by the government to avoid negative environmental and socio-economic impacts. It was found that population per unit area of built-up surface may serve as a good indicator of urban sprawl. Since the study area core is defined mainly to the Thanjavur municipality, detailed ward wise decadal analysis is made. The temporal changes were calculated along with population using Location Quotient Analysis, in the last two decades. It is also observed that the urban density is higher in the west zone and lower in the North zone as most of the northern part was covered by agricultural lands. The study investigated the population growth occurring in study area and the results shows that the overall growth in built-up area is in the south western parts. The present study highlights the concentration of population ward wise in the study areas, hence decentralization of smart utility services are necessary for the future planning. In order to ensure long term Sustainability, land resources management should be done efficiently using GIS.

KEYWORDS: Urban Sprawl, Location Quotient Analysis, GIS & Land Sustainability

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Original Article

INTRODUCTION

India has many resources with rapid population growth necessitates a proper planning by the government to avoid negative environmental and socio-economic impacts. According to the 2011 Census, urban India grew by 90 million people. Suburbanization is a common phenomenon in most urbanizing countries, what makes India's predicament particularly worrying is that it is occurring at a relatively early stage of India's urban development. Likewise, Thanjavur city is also developing beyond the municipal limits where to and fro is highly engaged as there is much of pressure on land. The Tamilnadu state has about 832 urban centres according to the 2011 census out of which nearly 310 towns have a population of more than one lakh (Class-1 towns). The study area is having an urban population of 2, 22,943 with 56836 households. The population reveals that gradual growth with the town population of 1, 40,547 in 1971 and 2, 22,943 in 2011 that indicates more than 1.5 times increased within a period of four decades. Urban density is one of the main terms used in urban planning as it is considered as an important factor in understanding how the urban areas are functioning. Urban density is the number of people living in a particular urban area, as number of people in a city grows beyond capacity, the local community person continues to spread and move farther and farther along from city centers. It is interlinking between population and the urban development, so in order understand the population, demography study has been carried out. Many literatures were collected from library books, journals, newspapers, internet, online journals etc for the present study.

LITERATURE REVIEW

NishaRadhakrishnan (2014) stated that there is no up-to-date information relating to land use/land cover, transportation network, census changes, etc., are available at the municipal and state level. **Praveen Kumar et al (2013)**have studied that the urban land use classification requirement for urban planners and also tells about the site suitability analysis using the technique weighted suitability method in the area of Tirupati. **Elisa Muzzini and Gabriela Aparicio (2013)** studied that the location quotient analysis confirms that urban areas are service-oriented economies, with wholesale and retail trades being main contributors to urban employment. **Chadchan and Shankar (2012)** dealt with in-depth analysis of various urban development and issues with the post LPG and increase in urban housing shortage. **Nina Singh and Jitendra Kumar (2011)** alarmed that the extent and pace of urban transformation will raise concern about the city sustainability and there is a need for equitable distribution of public resources and balanced spatial and territorial development, particularly through investments in urban infrastructure and services. **Nelson and Terry Moore (1993)** has argued that many states in USA managing urban growth so that development is directed to urban areas equipped to accommodate development and rural lands are preserved for resources and other non-urban uses. **Bothale and Sharma (2007)** have studied the population growth analysis; ward wise occupancy analysis was done for all the 60 wards in the Jodhpur city. Further, quantification of urban expansion was done based on spatial extent of urbanization, density analysis, Shannon's entropy values and jaggedness degree.

STUDY AREA

The present study is to access the urban population growth in Thanjavur city. Thanjavur, a historical city is located in the centre of the Cauvery delta region with agricultural land surrounding the town. It is located at 10°45' North latitude and 79°8' East longitude is at a distance of 350 km from Chennai, which is state headquarter. Thanjavur is a special grade municipality bounded by nearby revenue villages. The city spreads over an area of 36.33 sq. km area. The municipality is well connected by roads with the adjoining towns. The city and its surrounding area forms part of small plateau called Vallam table land. The soil is as fertile as richer, which comes in the next order, but irrigated crops are raised chiefly with the help of Grand Anaicut canal nearby it. This area has a gentle slope towards from west to east and the area is devoid hills. The study area has been shown in Figure 1.

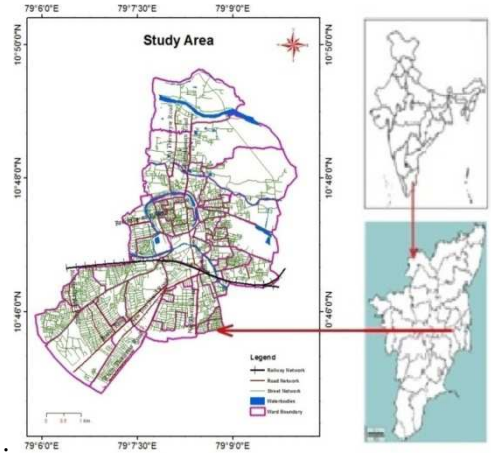


Figure 1: Study Area Map

METHODOLOGY AND MATERIALS

The methodology involves, demographic analysis followed by location quotient analysis. The year 2001 population concentration were mapped from the statistical data and converted in to digital format with the help of GIS. Next, for 2011, the same were mapped using location quotient analysis. Finally, the changes were mapped and measured to find out the growth. Based upon those the study has done to find out the concentration of urban population zone wise and also in ward wise in the study area. Further built ups are delineated using Resourcesat LISS IV images the area were calculated to find out the urban density.

DEMOGRAPHIC ANALYSIS

The population data spatially prepared and analyzed, it shows the population is higher in the south zone and lower one found in north zone and is shown in Figure 2(a) and ward wise population were classified into four categories and are shown in Figure 2(b). It shows that wards number 44 with high and ward number 8 with low population. Population density is a measure of population distribution and one of the most commonly used tools in the geographical analysis of the population. Here population is depicted in choropleth diagram shown in Figure 3(a) and also in the dot density where one dot represents 50 persons that are shown in Figure 3(b).

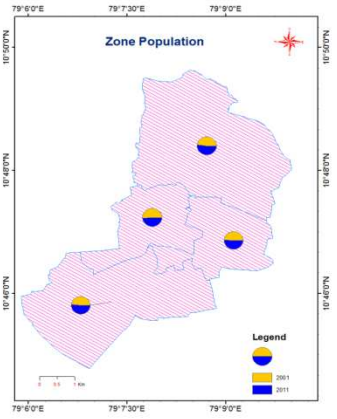


Figure 2(a): Zone Wise Population-2011

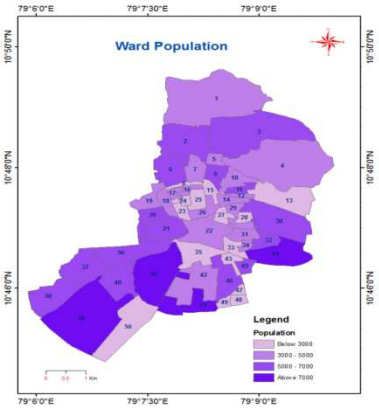


Figure 2(b): Ward Wise Population-2011

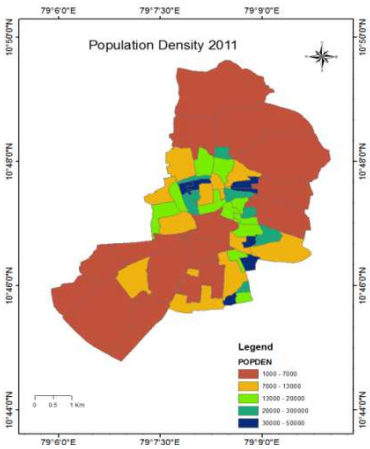


Figure 3(a): Population Density

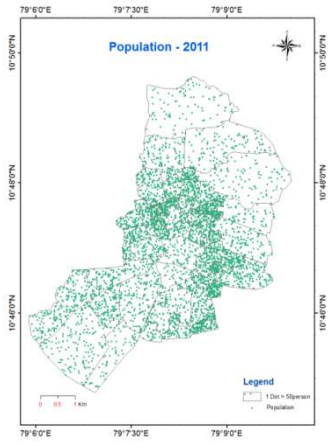


Figure 3(b): Dot Density Population

LOCATION QUOTIENT ANALYSIS

Location quotient is useful in demographic studies because it shows what makes the region's demographics unique in comparison to its state and / or the Nation. It is important to find out the relation of that aspect in terms of proportion may be important at local level and not at regional or country or state level. Location quotient is very helpful in order to find out the proportion of any aspect in a district in relation to the state or country. In a regional context, a higher or lower value of the location quotient indicates relative concentration or dispersion of the concerned attribute. Location Quotient gives us the relative picture of such proportion is defined as the ratio of the proportion of a particular characteristic in an area to the same proportion in the region, symbolically it can be defined as:

LQ =pij/P

Pj/P

Where pij = No of persons in j^{th}category of i^{th} area n

Pi = Total population in all the categories of area i

Pj = Sum of persons of category in all the n areas

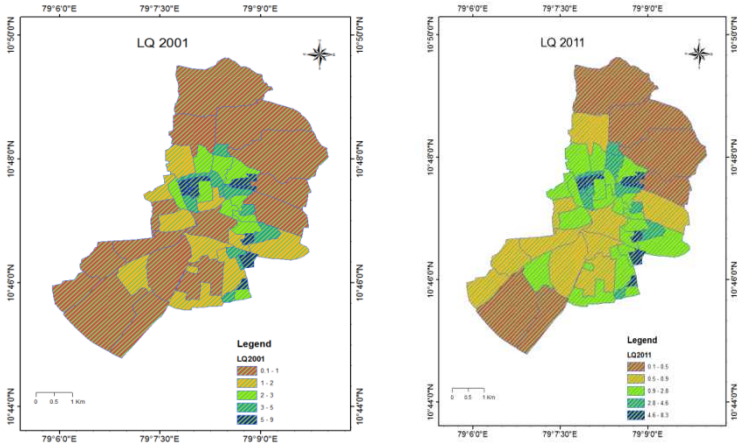
(i. e.) Population of region under category (j)

P = Sum of Pi in all the areas

(i. e.) Total population of the region in each category

Location Quotient Analysis Population (2001-2011)

Based on the location quotient analysis data for population and its spatial distribution has been prepared for 2001 and 2011 and shown in Table 1. Location quotient analysis are done to find out the concentration of population in each ward and are categorized into five categories for those two years which are mapped and shown in Figure 4 (a) and (b). The changes in population are more observed in central parts of the study area.



(a) **(b)**

Figure 4: Location Quotient Analysis (a) 2001 (b) 2011

Table 1: Population Location Quotient Analysis (2001 – 2011)

Ward Name	Area	2001			2011		
		Population	Density	LQ	Population	Density	LQ
1	3.3	4043	1225	0.21	4355	1320	0.21
2	1.25	4909	3927	0.66	5292	4234	0.69
3	3.02	5453	1806	0.3	5722	1895	0.31
4	4.04	4157	1029	0.17	4760	1178	0.19
5	0.14	4003	28593	4.82	3915	27964	4.55
6	0.69	5185	7514	1.27	6036	8748	1.42
7	0.34	4806	14135	2.38	4567	13432	2.19
8	0.09	2150	23889	4.03	1958	21756	3.54
9	0.29	4440	15310	2.58	5207	17955	2.92
10	0.34	4296	12635	2.13	4367	12844	2.09
11	0.16	4981	31131	5.25	5081	31756	5.17
12	0.07	3616	51657	8.71	3583	51186	8.33
13	1.01	2016	1996	0.34	2777	2750	0.45
14	0.19	4094	21547	3.63	3832	20168	3.28
15	0.17	3181	18712	3.15	2110	12412	2.02
16	0.11	4187	38064	6.42	3800	34545	5.62
17	0.1	3563	35630	6.01	3427	34270	5.58
18	0.23	3383	14709	2.48	3444	14974	2.44
19	0.43	3437	7993	1.35	4129	9602	1.56
20	1.29	5839	4526	0.76	6130	4752	0.77
21	0.52	3870	7442	1.25	4942	9504	1.55
22	0.84	3636	4329	0.73	3960	4714	0.77
23	0.14	2814	20100	3.39	3018	21557	3.51
24	0.1	3097	30970	5.22	2783	27830	4.53
25	0.23	2820	12261	2.07	2242	9748	1.59
26	0.25	2562	10248	1.73	3361	13444	2.19
27	0.16	2163	13519	2.28	2258	14113	2.3
28	0.11	2800	25455	4.29	2667	24245	3.95
29	0.26	3896	14985	2.53	4130	15885	2.59
30	1.25	4289	3431	0.58	5431	4345	0.71
31	0.26	4327	16642	2.81	4356	16754	2.73
32	0.27	6688	24770	4.18	6217	23026	3.75
33	0.2	2257	11285	1.9	2452	12260	2
34	0.09	3674	40822	6.88	3654	40600	6.61
35	0.61	4659	7638	1.29	2604	4269	0.7
36	1.21	6519	5388	0.91	6163	5093	0.83
37	1.13	4516	3996	0.67	5881	5204	0.85
38	1.49	4764	3197	0.54	5105	3426	0.56
39	2.58	7892	3059	0.52	7998	3100	0.5
40	0.68	5564	8182	1.38	6618	9732	1.58
41	1.46	7346	5032	0.85	7396	5066	0.82
42	1.01	4265	4223	0.71	4690	4644	0.76
43	0.17	3302	19424	3.27	2860	16824	2.74
44	0.9	7656	8507	1.43	8341	9268	1.51
45	0.17	5168	30400	5.13	5617	33041	5.38
46	0.58	5595	9647	1.63	5963	10281	1.67
47	0.07	2269	32414	5.46	2158	30829	5.02
48	0.19	2582	13589	2.29	2318	12200	1.99
49	0.14	2882	20586	3.47	3120	22286	3.63
50	1.26	2624	2083	0.35	2792	2216	0.36
51	0.71	7079	9970	1.68	7356	10361	1.69
Total	**14.36**	**84682**	**5897**	**1**	**86980**	**6057**	**1**

URBAN DENSITY

A most popular dimensional index of urban growth and sprawl is the urban density; it refers to the relationship between inhabitants and built-up area (BUA) per census district.

$D = P_i / \sum_{i=1}^{n} BUA_j$ Where P_i is the population of District.

The ward wise urban density has been worked out, based on the formula, ward wise spatial distribution has been prepared and it is shown in Figure 5. Here the built up area were delineated from the images and the area were calculated so as to find the built up density and the results were categorized. Results shows that higher density was found in the south western area and lower one in the northern part. The zone wise urban populations are also calculated and are tabulated in Table 2. From this it is clearly understood that the west zone urban density is highest in the last two decades and so the urban sprawl is towards the southern direction.

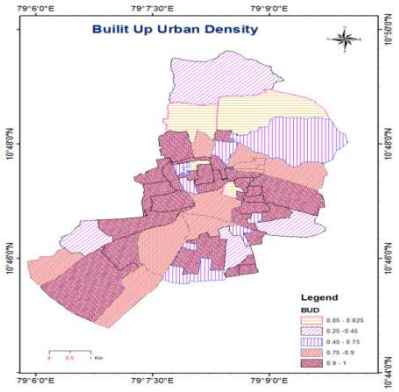


Figure 5: Ward wise Urban Density 2011

Table 2: Zone Wise Urban Density (2001-2011)

S. No	Zone	2001		2011	
		Population	Urban Density	Population	Urban Density
1	North	3942	320	4251	345
2	East	11426	2431	11736	2497
3	West	12465	2770	12096	2688
4	South	5576	541	5967	579

RESULTS & DISCUSSIONS

The present paper gives a vivid picture of the demography of the study area and its urban density was worked out for zone wise and ward wise. The temporal changes were also calculated along with population. In the last two decades, urban density is higher in the West zone and lower in the North zone. In order to plan and implement various developmental activities, spatial data and monitoring the dynamics of the urban land use are the two basic things for suitability analysis. Identification of suitable land for urban development is one of the current critical issues of smart planning. The suitability of land for urban development is based on a set of some physical parameters and economic factors. The cumulative effect of this factor determines the degree of suitability and also helps in further categorizing of the land into different orders of development. The assessment of the physical parameters of the land is possible by analyzing the land use, soil, slope, geology, flood hazard, physiographic, distance from the road network and railway stations, etc., and which are very much amenable to GIS analysis.

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